

Choosing Engineering Services for Your Commercial Property

"Engineering is safety by design"

Presented by:

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Understanding what engineers do

When you plan to modify, sell, purchase, or lease a commercial property, talk to a licensed engineer. Why?

- A commercial property is a significant investment. An engineer can help you ensure that your property is compliant with changing regulations, make appropriate and cost-savings modifications and/or modernizations, and check and maintain the safety of the interior and exterior of the property.
- Many regulations apply to structures that are accessed by employees or the general public (i.e., customers). These regulations ensure the personal safety of the occupants, protect the general surrounding public, and protect the environment. All commercial properties—large and small—are held to the same high level of standards.
- Failure to comply with these regulations can result in:
 - Substantial fines from government agencies such as OSHA, Federal and State EPA, and local building departments
 - Condemnation of properties
 - Requirements to tear down properties or redo the work

Your engineer will help you evaluate the feasibility and costs involved with modifications, sales, or purchases and the impact this will have on your business.

Do you need an architect or an engineer?

Most people associate architects with the look and layout of a building. Engineers are responsible for the strength and the functioning (heating, electrical, water and waste water, etc.) of a building. On large projects engineers and architects work as a team. On small projects the engineer does the entire project.

By law, only a licensed engineer can:

- Design structures other than buildings (i.e., bridges, large signs, towers, etc.)
- Design foundations and retaining walls
- Design septic systems (also requires a Title 5 Design license)
- Perform site planning and surveying
- Design drainage systems
- Perform environmental impact statements (State and Federal agencies only accept *impact statements*)

If you are planning significant changes, renovations, and additions, you need a licensed engineer.

Understanding the technical role and expertise of engineers

Very large complex projects require multiple civil engineers, many of whom are specialists. These are the typical roles of civil engineers:

- The **lead engineer** is a generalist who will call in additional experts if a project has special requirements. Typically, the lead engineer is responsible for balancing the three key project items:
 - **Scope** – the things that need to be completed to meet the project goal
 - **Resources** – the budget, the materials, the equipment, and the personnel that will be used to complete the scope
 - **Schedule** – the assignment of resources to the tasks, the estimation of costs and the time required to complete the project, and the proper sequencing of tasks
- The **site engineer** is responsible for modifying the land. Typical tasks include providing access to the site (roads, parking), creating the proper drainage, installing utilities (power, water, and sewerage), paving and landscaping, and ensuring that construction or repair can be done at the site. Temporary facilities (e.g., storage, construction roads, staging) are part of site engineering.

- The **structural engineer** sizes the components of any structures (buildings, bridges, towers, signs). The component must be strong enough to support all possible loads, stiff enough to control movements, and durable enough to withstand weather and daily use. Typical structural materials include metals (e.g., steel and aluminum), concrete, timber, and occasionally stone.
- The **environmental engineer** designs components necessary to protect the environment including air, water, and soil. The environment must be protected from contamination, hazardous materials, and noise. Environmental design must include interior and exterior locations.
- The **surveying engineer** determines property boundaries, maps existing terrain features, and accurately positions components at a site.
- The **traffic engineer** steps in when a project will generate significant vehicular traffic. Work includes determining traffic impact on existing roads, designing new roads and traffic controls (e.g., traffic lights), and handling special vehicle needs for large or heavy equipment.
- The **geotechnical engineer** is brought in when large structures must be supported or if soil conditions are poor. This can also involve vibrating equipment, unstable slopes, piles or other deep foundations, any type of tunneling, and properties near water (rivers, lakes, and oceanfront).

On small commercial projects, a licensed civil engineer can perform any or all of these engineering roles:

- **Electrical engineering.** This is required when a project involves high-voltage or specialized equipment. Sometimes the local power company will provide this expertise.
- **Mechanical engineering.** This is required when a project needs specialized machinery, such as heavy machinery, large ventilation systems, elevators, or other conveying equipment.
- **Architectural services.** Architectural work is responsible for the look and layout of any building.
- **Inspection services.** Inspections ensure that a project meets all regulations and is built *exactly as designed*. Government inspectors verify that all safety and environmental regulations are met. Large projects have internal inspectors to assure quality control. Most projects involve multiple inspections.
- **Construction services.** These are engineers who manage construction projects by tracking materials, equipment, personnel, and expenditures.

You need an engineer when...

Get an engineer when...

Here is a partial list of items that **will require** a licensed engineer.

- **All septic system changes or well installations.** A civil engineer, who holds a Title 5 Designer license, creates the design and plan and must sign the necessary Board of Health permit applications. Drawings bearing an engineer's stamp are usually required. Not all civil engineers are Title 5 Designers. A Title 5 Inspector cannot repair a failed system or design a new one.
- **Fences, walls, signs, or other structures installed near property lines.** Massachusetts requires minimum distances between structures and property lines and most towns have even more stringent requirements. A plot plan showing the property lines and proposed structures can only be created by an engineer and the plot plan is often submitted with a building permit application.
- **Swimming pools, fountains, and other water features.** An engineer must certify (with a plot plan) that water features are located safe distances from septic systems, wells, aquifers, and property lines. Proper fencing or other safety measures are required to prevent accidental drowning.
- **Structural steel (and other metals).** The engineer ensures three critical factors: the steel will handle the required loads, the connections are strong enough, and that the correct type of steel is used. Structural steel also requires fire-proofing because fire softens steel causing the structure to collapse.
- **Multi-business structures, malls, commercial condominiums, and combined residential-commercial properties.** Because any change in one property potentially affects the safety of the other occupants, an engineer is required for all but the most minor changes.
- **Decks, platforms, loading docks, bridges, elevated walkways.** These structures and other conveyance systems that will support people or animals must be designed by a structural engineer and constructed under his or her supervision.

You may need an engineer if...

Here is a partial list of items that **generally require** an engineer.

- **Foundations** for all but the smallest structures. Because ground conditions vary for every site, there is no such thing as a standard foundation. The engineer will match the foundation design to the ground conditions to support the structure and control the amount of settling that will occur.
- **Drainage changes.** These are strictly governed in Massachusetts. Storm water (rain water) must meet tough environmental laws governing the amount and speed of runoff and water quality. Special structures are usually required to ensure proper infiltration of water back to drinking water supplies. Other conditions include regrading, paving, installation of structures, and safe distances from wetlands.
- **Excavation.** This always requires a call to 1-800-DIG-SAFE, and may require an engineer to provide erosion control and other site hazards (dust, wetland protection, temporary drainage). This is usually done with hay-bales staked to the site, drainage fences, and similar low-cost solutions. The placement of these devices is critical and thus requires an engineering report.
- **Significant or unusual structures.** This includes sheds, large signs, ham-radio antennae, loading docks, and any non-standard structures. The engineer ensures the structure has sufficient strength and that unacceptable movements are limited. While architects may perform this service, any work involving unusual construction or large open spaces requires a structural engineer.
- **Utility installations (water, electricity, natural gas, and municipal sewer).** While the utility company provides this service for typical installations, any special requirements (e.g., large electrical loads, water treatment and purification, up-hill connections to municipal sewer lines) will require your own engineer. If municipal sewer is not available, you must hire a licensed engineer.
- **Refinancing, construction loans, and most property sales.** Most loans and sales require a plot plan showing the location of all property lines, structures, fences, and other significant features is usually required by the financing institution (bank, credit union, or mortgage company). This assures all parties of what is being sold. Rights-of-way and other provisions allowing access to the property (e.g., power lines, drainage pipes, and future driveways) are usually included on this plan. A licensed civil engineer can provide this plan plus any additional engineering reports.
- **Garbage disposal and trash handling devices.** Because these devices can affect the environment and create safety and health hazards, a licensed engineer is required.
- **Handicapped access to a property.** Federal and state laws dictate special requirements for safe handicapped access including additional railings, ramps of limited slope, and life-safety equipment. Even temporary medical situations (e.g., the use of oxygen for breathing) can create hazards not anticipated when your business was established.
- **Reinforced concrete (except simple walkways).** Reinforced concrete is a very economical material, but it can be very difficult to get right. The engineer will ensure that the correct amount of reinforcing steel is installed in the right places and that the proper concrete mixture is used. For large or complex concrete installation, an engineer may also be required to design the forms to hold the wet concrete.
- **Special construction.** Typical examples include sound-proof structures, low-vibration, super-insulated buildings, high wind locations, and buildings subject to high water-tables. Many contractors are not familiar with the special needs these construction types require and will need engineering guidance.
- **Heavy items.** These can overload your property and include waterbeds, libraries, training rooms, spas, oversized tubs, commercial appliances, marble/granite countertops, and heavy inventory items (e.g., stone). Before installing such heavy or unusual loads, have an engineer inspect the structure and design any necessary additional supports.
- **Home offices and other work-at-home installations (These may be considered commercial property).** *These special uses present hazards not anticipated in typical home construction.*
 - The hazards include: heavy floor loads (from books, paper, equipment, or supplies), overloaded electrical circuits, radio/TV interference, and other power-quality problems, special lighting or other equipment that is not rated for home use, and increased fire hazards.

- Workshops may also present new hazards such as flammable dust and solvents, environmental and personal safety hazards, and proper handling of waste products (e.g., petroleum products).
- Special insurance is generally required and may require an engineering report.
- **Driveways, parking areas, and other pavements.** Massachusetts and many towns have legal requirements. Slopes are limited for winter conditions, provide for the safe storage of vehicles, etc. Curves and configurations must allow the vehicle to turn. Boats, trailers, and trucks require special curves and stronger pavement. Drainage is mandated for commercial parking areas and requires an engineer. In some cases, special access for emergency vehicles must be considered.

How engineers help your commercial property...

Meeting regulations ensures the safety of everyone

Current regulations encompass hundreds of thousands of pages. Understanding these regulations and staying current with changes and additions is a full-time occupation and is one of the roles of your licensed engineer. Most commercial properties, even small properties, must comply with these major regulations:

- State Building Code
- Professional guidelines referenced by the building code (e.g., steel and concrete design standards)
- State Electrical and State Plumbing Codes
- NFPA Life Safety and Fire Codes
- Municipal regulations such as zoning, planning, and local engineering rules, which vary by town
- Environmental regulations from the Federal EPA, State DEP, and local conservation commissions
- Health regulations from the Federal EPA, State DEP, MA Title 5, and the local Board of Health
- Other common regulations from the County Registry of Deeds, Federal DOT standards, MA Storm-Water Management Guide, and the ADA (handicapped) regulations.

Understanding Permits, Plans, Variances, and Inspections

This section covers the types of permits that a job may require, describes the planning and review process, clarifies the relationship between variances and hearings, and explains the role of inspections. Your licensed engineer understands these processes and produces the documents required to obtain the permits.

Permits

Commercial properties always require *permits*. Permits are the government's method to insure that proper procedures are followed. While sometimes tedious, the permit process ensures that we all stay safe.

Permits fall into several categories:

- **Usage and occupancy permits** ensure that a site's usage is consistent with the good of the community. Zoning regulations provide structure to prevent conflicting use of neighboring properties and to ensure that a balance between activities (living, shopping, and manufacturing) is possible. A *Certificate of Occupancy* is generally the final permit and ensures that all other permits have been obtained.
- **Building permits** ensure that work is done properly, safely, and that qualified persons do the work. Most projects will require a building permit, an electrical permit, and a plumbing permit. Other permits might include: demolition permits, elevator (or other machinery) permits, and environmental agency permits (e.g., state Dept. of Environmental Affairs).
- **Zoning and planning permits** ensure that the project meets locally accepted standards for safety and social acceptability.
- **Environmental permits** ensure that surrounding areas are not harmed by a project. They are issued by the state DEP, the Conservation Commission, and the Board of Health
- **Safety permits** ensure the safety of employees and the general public. Typical permits cover fire safety, and health department regulations.

- **Business permits and licenses** ensure that the business operations conform to public policy and provide for revenue generation.

Plans and Reviews

To obtain a permit, an application is always required. The application explains the work to be done. Most building, zoning, planning, environmental, and safety permits required a *technical plan* in the form of reports, specifications, and technical drawings. Engineers and other professionals prepare the required technical plans according to government guidelines. The technical plan is then certified as being complete and correct by applying a stamp (or seal) along with the signature of the licensed engineer. The technical plan is then submitted to the appropriate government agencies.

The technical plan is then *reviewed* by the appropriate government agency. If clarifications are required, the technical plan is returned to the submitter. Because of the complexity of most projects, several revisions to the plan are generally needed and sufficient time must be allocated to complete the process.

Variations and Hearings

If the technical plan does not or cannot meet all government requirements, then the submitter must apply for a *variance*. When the project will impact the general public, requires government participation, or a variance is required; the government will schedule one or more *hearings* to allow the public to voice their concerns. The reviewing agency combines the public’s concerns with policy and makes a decision. Often this decision requires additional changes to the technical plan. The review process begins again and more hearings may be needed.

Inspections

The work can only begin when all permits have been obtained. Most permits have one or more *inspections* required to ensure the work is properly performed. Electrical and plumbing permits usually have a “rough” inspection to check work that will be covered by walls and floors and a “final” inspection when the work is ready to actually be used. Building permits often have several inspections: demolition, foundations, framing, mechanical systems, finish work, and a final review.

Modifying usage requires permits and meeting new regulations

Commercial property usage often changes: an office switches to light manufacturing; a retail store becomes a service facility; or an existing tenant reconfigures space to match business needs. These are all called a *modified usage* of the property. **Any modified usage of a commercial property requires new permits.**

While this may seem excessive, just moving an office partition could affect the fire escape routes or access to fire protection equipment (e.g., extinguisher or sprinkler). Consult an engineer before making any changes to a commercial property. Your life and the life of others might depend on it!

Usage changes are not limited to the interior of a property. Modified usage can include exterior changes. For example, parking and handicapped accessibility change based upon the intended usage. Further, any change to a commercial property requires that all new regulations (since the last change in usage) must now be met. A licensed civil engineer can help to coordinate all these changes and help to obtain the new permits. Failure to meet regulations can result in your business being shut down until changes are made.

Inspecting commercial properties for safety and compliance

Because home inspectors are not sufficiently trained to review commercial properties, a licensed engineer is needed. A typical review of a commercial property is about 0.5% of the estimated property value.

Inspect, verify, and update	Determine size and/or adequacy of	Test
<ul style="list-style-type: none"> • Inspect septic systems. • Inspect electrical systems, 	<ul style="list-style-type: none"> • Electrical power sufficiency including circuit sizing and 	<ul style="list-style-type: none"> • Anti-siphon devices. • Water-conditioning system,

<p>such as telephone, security alarms, cable TV, fire alarms, and other communications systems.</p> <ul style="list-style-type: none"> • Verify code compliance (building, fire, plumbing). • Calculate size, strength, or adequacy of any system or component including the building's frame. • Update plot plans locating major structures, fences, signs, pavements, property lines. • Compliance for handicapped access or other special uses. 	<p>breaker capacities.</p> <ul style="list-style-type: none"> • The plumbing system, hot water supply, water pressure, and drainage sizes. • Heating systems or individual components • Cooling systems or components. • Insulation system and required air exchanges. • Air quality levels, proper storage of hazardous materials, contaminants in soil, other environmental issues 	<p>sprinkler systems, water quality, or adequacy of water supply (including wells).</p>
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Saving money and protecting commercial property investments

A periodic review of your commercial property by an engineer can save you money. Use the technical expertise of an engineer for:

- **Site reviews.** Just like your home, a site inspection of the interior and exterior of your commercial property can catch little problems before they become big expenses.
 - A mini-version of the commercial property review can detect maintenance issues such as leakage, settling, and structural fatigue.
 - Some systems (e.g., septic systems) require periodic review.
 - A proposed change in site usage may require an assessment of
 - property lines and set backs
 - drainage
 - parking lots and other pavements (walkways, courtyards)
 - landscape design
 - outdoor lighting
 - utilities—locating, moving, increasing
 - zoning and variances
 - impact to wetlands
 - soil conditions and evaluation
 - general suitability
- **Improved working environment and improved worker efficiency.** Internal air pollution, excessive noise, poor lighting, and other factors can significantly lower worker productivity, increase injuries, and result in high absenteeism. An engineer can help identify problems, propose solutions, and estimate cost-benefit ratios.
- **Planning for conformance to new regulations.** Environmental regulations and OSHA requirement are constantly evolving. Building codes (e.g., the National Electrical Code) are updated every few years. An engineer can help you stay current with new regulations and to plan for their implementation before they become a crisis.
- **Review of new technology / infrastructure improvements (e.g., communications, internet, wireless technologies) for full implementation costs.** Engineers are a technical consulting resource who can help you understand the cost and the impact of new technologies for your business. Infrastructure installation and maintenance can represent a significant expense.
- **Capital improvement assessments and factory automation opportunities.** An engineer can help you estimate the trade-offs between reconfigurations, repurposing existing space, expanding existing space, or building / buying new space by preparing construction cost estimates and schedules.

- **Energy usage reviews.** Electric power, water, and other utilities are expensive. An engineer can help you measure current usage, predict future usage, and find more efficient solutions.
- **Natural disasters, environmental changes, etc.** When the unexpected happens, emergency inspections can be needed. Natural disasters or severe weather conditions such as heavy rains, high winds, heavy deep snow, flooding, and severe heat can damage the structural integrity of your commercial property. Other unexpected conditions, such as local blasting operations, nearby fires or explosions, new adjacent construction, and heavy vehicles or traffic can also affect your property. An engineer can evaluate any changes or damage that has occurred and create a recovery plan for you.

For more information

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Glossary

ADA - [Americans with Disabilities Act](#). The Americans with Disabilities Act gives civil rights protections to individuals with disabilities similar to those provided to individuals on the basis of race, color, sex, national origin, age, and religion. It guarantees equal opportunity for individuals with disabilities in public accommodations, employment, transportation, state and local government services, and telecommunications.

EPA - [Environmental Protection Agency](#). The U.S. Environmental Protection Agency (EPA) was created in 1970, through an executive reorganization plan, as an independent regulatory agency responsible for the implementation of federal laws designed to protect the environment.

DEP - [Department of Environmental Protection \(Massachusetts\)](#). The Department of Environmental Protection is the state agency responsible for ensuring clean air and water, the safe management of toxics and hazards, the recycling of solid and hazardous wastes, the timely cleanup of hazardous waste sites and spills, and the preservation of wetlands and coastal resources.

DOT - [Department of Transportation](#). Federal or state agency that oversees highway, air, railroad, and maritime and other transportation administration functions.

OSHA - [Occupational Safety and Health Administration](#). This is the main federal agency charged with the enforcement of safety and health legislation.

MA Title 5 - [Massachusetts Title 5](#). This Massachusetts state law governs the design and installation of septic systems.

NFPA - [National Fire Prevention Association](#). The mission of the international nonprofit NFPA is to reduce the worldwide burden of fire and other hazards on the quality of life by providing and advocating consensus codes and standards, research, training, and education.

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